

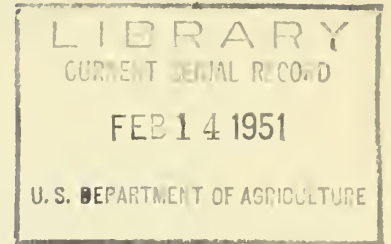
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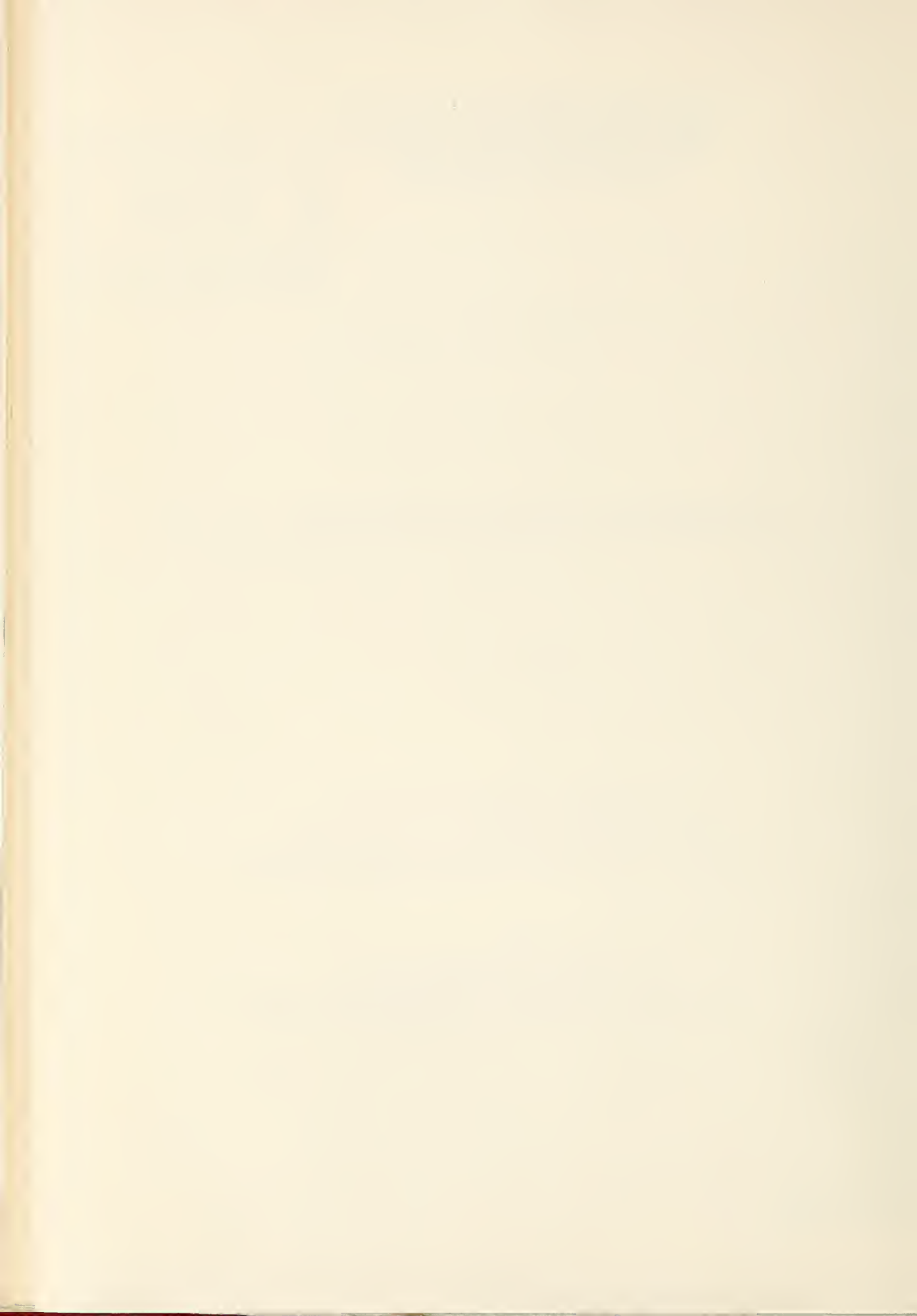
A Comparison of Transit Protective Services  
for Bartlett Pears During the Early Part of the Shipping Season

By

A. Lloyd Ryall, Senior Horticulturist  
James R. Clements, Agent  
W. A. Radspinner, Associate Horticulturist  
Division of Fruit and Vegetable Crops and Diseases

and  
F. W. Allen, Pomologist  
R. W. Harris, Junior Pomologist  
University of California, College of Agriculture,  
Division of Pomology, Davis, Calif.

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A Comparison of Transit Protective Services for Bartlett  
Pears During the Early Part of the Shipping Season

Problem and Background

Bartlett pears from the Sacramento River and Yuba City districts are harvested and shipped earlier than those from any other producing areas. Climatic conditions in these two districts favor early maturity and as the market ordinarily pays a premium for early season products there has been a natural tendency to begin the harvest as soon as the maturity requirements, specified by state law and trade agreements, can be met.

Tests conducted in 1941 and 1942 had indicated that standard refrigeration was not necessary for the movement of early season Bartlett pears. The report of this work for 1942 <sup>1/</sup> states that "Early shipments of Bartlett pears from California were benefited by transit temperatures high enough to allow some development of color as long as too much softening did not take place. Average temperatures of 54° - 56° were satisfactory but at 62° a few pears were too ripe on arrival." Despite these findings much of this early fruit has been precooled before shipment and the major part of it has moved under standard refrigeration service. The combination of minimum maturity and relatively low transit temperatures has resulted in this fruit arriving in the eastern markets hard and green. A considerable ripening period was then required before early pears were usable by the consumer. This meant either that the pears were held by the wholesaler or retailer for ripening, or that the consumers were offered green pears which were not conducive to repeat sales. Under either circumstance there was a delay in getting the pears into consumption and with additional shipments arriving continuously at the market there was some tendency for market gluts with consequent price depression. Furthermore previous experimental work has demonstrated that the prevailing temperatures during July and August in most eastern cities are above the optimum for Bartlett pear ripening. It has been observed that in certain seasons Bartletts ripened after unloading have shown poor color and quality and considerable amounts of breakdown.

With these consideration in mind representatives of the Bartlett pear industry requested that additional experimental work be conducted on the transportation of early season Bartlett pears to determine whether protective services could be devised which would allow partial ripening in transit and still provide adequate protection against over-ripeness and decay. As a result of these requests from the industry, the transportation test reported, herein, was planned and conducted.

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<sup>1/</sup> Report on Experimental Work Dealing With the Precooling, Transit Refrigeration, Ripening of California Bartlett Pears During the 1942 Season. W. T. Pentzer, C. O. Bratley, A. Lloyd Ryall, James S. Wiant, U. S. Department Agriculture, F. W. Allen, N. T. Hartmann, California Agricultural Experiment Station. C. N. McClanahan, Warren G. Tufts, California Tree Fruit Agreement, Sacramento California



## Materials and Methods

### Test Cars

Eight Pacific Fruit Express cars of the same series and in excellent condition were used as test cars. All were steel sheathed, and had comparable insulation (3" and 3 1/2"). All the cars had fixed bulkheads, side wall flues, and were equipped with Preco floor fans. Bunker capacity was 11,500 pounds for full bunker icing and 6,500 pounds with the racks in the half-stage position.

### Temperature Records

All temperature readings within the cars were made by means of electrical resistance thermometers which could be read without opening the car. Fruit temperatures were taken at 10 positions in each car with the thermometer bulb inserted in a fruit near the center of the box at each position. Nine of the fruit temperatures were taken along the centerline of the car with 3 in the stack next to the bulkhead (top, middle, and bottom layers), 3 in the quarter-length stack, and 3 in the doorway stack. The tenth fruit temperature was taken in a top layer box at the quarterlength and adjacent to the south wall of the car. Air temperatures were taken beneath the floor rack at the intake side of the fans, and at the doorway about 12 inches above the load.

### Protective Services

The protective services used in the 8 test cars are shown in Table 1. All were aimed at giving less than maximum refrigeration. Partial precooling was used for cars C and D one of which (C) was precooled for about 9 hours by operating the Preco fans with electric motors for the period from completion of loading until train time. Car D was cooled about 17 hours by the use of portable, kerosene-powered engines which drove the Preco fans. The kerosene engines were attached as soon as loading was completed and operated while the car was standing at the loading shed and during the period it was being moved from the loading point to the Sacramento yards.

Two of the cars (A and B) were modified before loading for by-passing the ice bunker with part of the air delivered by the Preco fans. It has been demonstrated previously in work with lemon transportation (H.T.&S. Report #195) that when this is done slower cooling and higher average transit temperatures can be obtained than in cars where all the air from the fans moved through the ice bunkers. However, a somewhat different method of diverting air was used in this test than had been used in the lemon cars. The floor board next to the bulkhead was removed at each end of the car and a false bulkhead, similar to those used to take care of the slack in through loads, was used against each bulkhead. When the car was loaded the false bulkhead provided a flue between the load and the bulkhead. The top opening of both bulkheads were covered with heavy building paper in which a 6 by 12 inch opening was cut at each end of the car. It had been predetermined by tests with an empty iced car with the Preco fans in operation that when the top bulkhead opening was sealed except for a 6 x 12 inch opening enough static pressure was created by the fans to divert about half of the air up the





channel between the false bulkhead and bulkhead. Thus only about half the air passed through the ice bunker and refrigeration was reduced without materially affecting total air movement in the car. Cars A and B with restricted air circulation were moved under modified protective services with upper half-stage icing. Car A was initially iced after loading while Car B was pre-iced and replenished. Both cars had 2 re-icings in transit.

Cars E and F afforded a comparison of fans on and fans off with the same modified protective service (2<sup>F</sup>4a) while cars G and H were both moved under upper half-stage standard refrigeration with the fans on in Car G and the fans sealed off in Car H.

### Load and Loading

All of the test cars were loaded between 8 A.M. and 4 P.M. on July 11 with 722 standard pear boxes loaded on their sides. Data on the type of load used, loading point, fruit temperatures at loading, etc., are shown in Table 2.

### Train Schedule and Icing Records

The schedule of the train is shown in table 3. Records of the amount of ice added enroute were made on the basis of measurements by the PFE estimators (Table 4). As natural ice of variable block weight was used at several icing stations records could not be kept on a block count basis. Initial ice figures are based on bunker capacity as furnished by the Pacific Fruit Express Company. Estimates of ice remaining in bunkers at unloading were made by members of the test party.

### Test Boxes

Test boxes were packed the afternoon prior to the day of loading. Twenty boxes of freshly harvested pears from the same orchard and of uniform size (165's) were obtained from the Sacramento River district and the same number similarly prepared were obtained from the Yuba City district. As shown in Table 5 fruit from the Stillwater Orchard averaged 20 pounds at time of packing while that from New England Orchard showed an average firmness of 21.4 pounds. Both lots were about 1.5 in color. Four boxes of each lot were taken to Davis for holding tests and the remaining 16 boxes were distributed among the 8 test cars. During loading one test box from each lot was placed at the bottom bunker position and one box from each lot was loaded at the top doorway position. Thus each test car contained 4 test boxes representing 2 orchards and 2 positions in the car.

### Route

The test cars moved via Southern Pacific, Union Pacific, Chicago Northwestern, Indiana Harbor Belt, and Erie. The test train schedule is shown in Table 3.

## Results

### Outside Temperatures

Figure 1 shows the outside temperatures encountered during the course of the trip. Relatively high maximum temperatures were recorded during the



first three days in transit but these are normal for July. Temperatures through the middle west were probably somewhat below normal while those in the east were normal or slightly below. On the whole it was probably about an average temperature record for that season but a considerably higher average temperature would not have been unusual.

#### Fruit Temperatures in Transit

Average fruit temperatures (top layer, bottom layer, and all positions) are shown graphically in Figures 2 to 9.

#### Effects of Air Diversion

Temperature records for cars A and B in which part of the air was diverted from the bunkers are shown in Figures 2 and 3. The curves indicate that the cooling rate was slower in Cars A and B than in any of the other cars under test. In Car A, which was initially iced after loading, the average fruit temperature did not reach 60°F. until the afternoon of the fourth day after loading. A 50° average fruit temperature was reached only briefly near the end of the transit period. At Carlin, Nevada, two additional 6 by 12 inch openings were cut in the paper covering the top bulkhead openings. The effect this had on cooling rate can only be estimated by comparing the cooling rate of Car A with that of Car B in which additional openings were not cut in the bulkhead covering until it reached Chicago. The figures show that from Carlin to Chicago cooling was somewhat more rapid in Car A than in Car B and that the additional openings in Car B at Chicago apparently speeded the cooling rate somewhat.

Car B was pre-iced, consequently the fruit was somewhat cooler, particularly in the bottom layer, than that in Car A when the cars were assembled at Roseville. The average fruit temperature in Car B reached 60° on the third day after loading but cooled very slowly thereafter.

Unfortunately no direct comparison can be made between cars with diverted air (A and B) and those with normal air movement since they did not have exactly the same protective services as the other test cars. However, some comparison can be made between fruit temperatures in cars A (diverted air) and G (normal air movement) both of which were shipped under upper half-stage icing and were initially iced after loading. From the time of initial icing to arrival at Ogden the fruit in Car A cooled an average of 11 degrees. The average fruit temperature in Car G dropped 17 degrees during the same period. Car G received one more icing during this period than Car A but there was ice adequate to provide good refrigeration in Car A during all of this period.

#### Precooled Loads

Figure 4 shows the average fruit temperatures obtained during precooling and transit in Car C which was precooled for approximately 9 hours with Preco fans run by electric motors. Salt (250 pounds) was added before precooling was started and the bunkers were re-iced once during precooling. An average of about 10 degrees was removed from the load during precooling and the temperature continued to drop rather rapidly during the early part of the transit period. The average load temperature dropped below 50 degrees during the



morning of the second day after loading and was between 40 and 45 degrees for the major part of the transit period despite the fact that the car received only one re-icing in transit.

Fruit temperatures in Car D, which was precooled for about 17 hours after loading are shown in Figure 5. Salt (318 pounds) was added before precooling started and the bunkers were reiced twice during precooling. An average of about 15 degrees was removed from the fruit during precooling and temperatures continued to drop during the early part of the transit period. The average fruit temperature was below 45 degrees for almost 5 days and below 50° during most of the transit period. After replenishing at Roseville the car received no further ice and although the bunkers were completely dry during the last 2 days before unloading the average fruit temperature rose only about 8 degrees during this period.

#### Effects of Preco Fan Operation

Figures 6, 7, 8 and 9 show the effect of forced air circulation on fruit temperatures. As has been previously demonstrated there was materially less spread in temperature between top and bottom layer fruit temperatures in Cars E and G with forced air circulation than in Cars F and H in which air circulation was by natural convection only. Cars E and F had the same protective service (Rule 254a) and Cars G and H were both moved under half-stage standard refrigeration. Top layer temperatures in both Car F and Car H were rather high throughout the transit period and the fruit in the top layer was somewhat more advanced in color than desired by auction buyers.

#### Ice Meltage

The amount of ice added to each of the test cars and the total amount used in each car are shown in Table 4. The least ice meltage occurred in Car A which was initially iced after loading and in which part of the air was diverted to by-pass the bunker. The cars which were pre-iced before loading generally used more ice than those initially iced after loading as a considerable refrigeration loss occurred during the several hours the pre-iced cars were standing with doors open during loading and bracing. It is interesting to note that Car A with half-stage icing and diverted air required only 3,200 pounds of ice at Carlin whereas Car G under half-stage standard refrigeration and with normal air movement required 3,800 pounds of ice at Sparks and an additional 2,700 pounds at Carlin or a total ice meltage to Carlin of 6,500 pounds, which was more than double the amount melted in Car A. Both cars were initially iced after loading and moved with fans on. Initial fruit temperatures in Car A were somewhat higher than in Car G.

As would be expected, total ice meltage was somewhat greater in Cars E and G with fans on than in Cars F and H with fans off.

#### Condition of Fruit in Test Boxes

Immediately after the test cars were unloaded on the evening of July 20 the test boxes were moved to the New York Laboratory. The following morning all boxes were opened and determinations made for firmness, color, and soluble



solids. All remaining fruits were placed at 67° to 68° F. for determination of the rate of ripening and market life.

Average figures for firmness, color, and soluble solids of the test fruit are shown in Table 5 together with figures showing the temperature conditions during transit. The fruit from the Sacramento River district was somewhat more mature at harvest than that from the Yuba City orchard, as indicated by average firmness, and this difference was reflected in somewhat riper pears after the transit period. The only pears of either lot which showed significant softening between packing and unloading were those which were in Cars A and B (diverted air cars) and those from the top layer positions in Cars F and H (fans off). Pears from the bottom layer positions of Cars F and H and those from either top or bottom layers in Cars C and D (precooled) and E and G (fans on) had changed very little in either firmness or color from the condition at time of packing.

In Table 6 are shown the records obtained during the holding period at 67° to 68° at New York. The time required to reach an eating ripe condition (firmness 3 lbs. and color of 3 1/2 to 4), and the number of days after reaching this stage before breakdown and mealiness was present in a sufficient number of pears to seriously affect salability, are shown together with the total period after unloading that the fruit was considered suitable for sale. It will be noted that pears from Lot 1 required from 3 to 7 days to reach the eating ripe stage while in Lot 2 this period varied from 3 to 10 days. As would be expected the test lots from the cars with the higher transit temperatures were the first to reach the eating ripe condition. In general the total marketable period was greater for the lots which had the lowest transit temperatures but the number of days the fruit was salable after reaching the eating ripe condition did not vary greatly between lots.

#### Holding Tests at Davis

Pears from the same lots as those included in the test cars were held at Davis for the transit period under constant air temperatures (variation one or two degrees) of 44°, 50°, 59° F. The results are shown in Table 7.

At 44° the fruit showed little ripening but at 50° and at 59° F. it softened and colored considerably. There was more ripening at a given temperature in the holding test than in transit. The best explanation for this is that in the holding tests the fruit was probably somewhat warmer than the temperature indicated which were air temperatures and not fruit temperatures as they were in transit.





Discussion

The results reported above show that in this transportation test non-precooled Bartlett pears of minimum maturity, with fruit temperatures at loading in the 70° to 80° range, shipped in average July weather under modified protective services in well insulated refrigerator cars of good construction and equipped with fans ripened very little during the 10 days in transit from California to New York City. Modified icing, as used in these tests, did not provide the higher temperatures required for the partial ripening of pears in transit. In the cars with forced air circulation a relatively small average amount of ice in the bunkers supplied enough refrigeration to hold the pears at a temperature at which no measurable ripening occurred. On the other hand in cars without forced air circulation the top layer fruit cooled too slowly, even under half-stage standard refrigeration, whereas the bottom layer received more refrigeration than desirable.

The diversion of air so that only part of it passed through the ice bunker and the remainder was recirculated within the loading space of the car maintained the intermediate temperatures required for partial fruit ripening and at the same time provided uniform temperatures throughout the car. It must be remembered, however, that in warmer weather and with poorer refrigerator cars restricted air circulation probably would have cooled too slowly to give protection against over-ripening of the pears during the transit period. The data indicated that as a margin of safety somewhat more refrigeration should be provided than that given cars A and B. A safe service for non-precooled pears in cars equipped for air diversion would probably be half-stage icing Rule 254c (pre-ice, replenish, and 3 re-icings). By re-icing at approximately 48 hour intervals after replenishing, sufficient refrigeration should be supplied to take care of even extreme conditions.

The data indicate that precooling is not necessary for early season Bartlett pears moved in fan cars. However, fruit in cars without fans probably should have some precooling in order to avoid the material temperature spread between top and bottom layer fruit as shown in Cars F and H.

As shown in Figures 10, 11, and 12, somewhat over 100 hours at temperatures between 55° and 75° F. was necessary to accomplish any measurable ripening of minimum maturity Bartlett pears during the transit period. Fruit in the top layer of Cars A, B, F, and H was at a temperature between 55° and 75° for periods of from 145 to 225 hours and fruit of Lot 1 from the top doorway position in these cars softened materially during transit. Cars C, D, G, and E all showed less than 90 hours of fruit temperatures in the ripening range and at unloading the fruit was as firm or firmer than when it was packed.

It would appear desirable that the operators and manufacturers of refrigerator cars consider the possibility of providing a means for simple diversion of air in fan cars so that intermediate temperatures could be maintained for those commodities which are injured by low temperatures and for those in which some ripening during transit is desirable.



Acknowledgments

The assistance of the California Tree Fruit Agreement and the California Grape and Tree Fruit League in planning and arranging the test is appreciated as is the help given by representatives of the Pacific Fruit Express Company, Preco, Inc. in loading the test cars and obtaining transit records. Accommodations for the test party were supplied by the Southern Pacific, Union Pacific, Chicago Northwestern, and Erie railroads. Appreciation is also extended to the many pear shippers and receivers who participated by supplying loads for the test cars and by maintaining the special conditions desired for test purposes.

The members of the test party were:

A. Lloyd Ryall, U. S. Horticultural Field Laboratory, Fresno, Calif.

James R. Clements, " " " " " "

F. W. Allen, University of Calif., College of Agriculture, Davis, Calif.

Forrest Jones, Pacific Fruit Express Company, Roseville, Calif.



Table 1 Protective Services for Bartlett Pear Test Cars

Sacramento, Calif., to New York, N.Y.

July 11 - 20, 1950

Car Symbol	F F E No.	Bunker Setting	Preco Fan		Rule
A	3838	Upper half stage	On	Restricted circulation through bunkers, loaded dry, initial ice at Roseville, re-ice at Carlin, Nevada and Council Bluffs, Iowa.	247b
B	3692	Upper half stage	On	Restricted circulation through bunkers, pre ice before loading, replenish at Roseville, re-ice at Carlin, Nevada and Clinton, Iowa.	254b
C	3666	Full	On	Pre-ice before loading, precool by shipper 9 hours with Preco fans operated at loading point, re-ice by shipper during precooling, replenish at Roseville, re-ice at Chicago.	254a
D	3647	Full	On	Pre-ice before loading, precool by shipper 17 hours with Preco fans operated with portable motors, re-ice by shipper during precooling, replenish at Roseville.	254
E	3546	Full	On	Pre-ice before loading, replenish at Roseville, re-ice at Council Bluffs, Iowa.	254a
F	3492	Full	Off	Pre-ice before loading, replenish at Roseville, re-ice at Council Bluffs, Iowa.	254a
G	2636	Upper half stage	On	Loaded dry, initial ice at Roseville, re-ice at all regular icing stations.	Std. Refrig.
H	3363	Upper half stage	Off	Loaded dry, initial ice at Roseville, re-ice at all regular icing stations.	Std. Refrig.



Table 2 Car Loading Data

California Bartlett Pear Transportation Test  
Sacramento, Calif., to New York City, July 11 - 20, 1950

Test Car	A	B	C	D
PFE <sup>1/</sup>	3838	3692	3666	3647
Loading Point	Hood	Walnut Grove	Pearson	Walnut Grove
Shipper	Stillwater orchards	Amer. Fruit Growers	DiGiorgio Fruit Corp.	Pacific Fruit Exchange
Load	722 boxes <sup>2/</sup>	722 boxes <sup>2/</sup>	722 boxes <sup>2/</sup>	722 boxes <sup>2/</sup>
Protective Service	Restricted air H.S., 24 <sup>7b</sup>	Restricted air H.S., 25 <sup>4b</sup>	Precooled 9 hrs., 25 <sup>4a</sup>	Precooled 18 hrs., 25 <sup>4</sup>
Fans	On	On	On	On
Loading time				
Start	8:15 A.M.	9:00 A.M.	8:10 A.M.	8:45 A.M.
Finish	11:30 A.M.	12:00 M.	11:30 A.M.	2:45 P.M.
Fruit temperatures during loading, °F.	72 to 78	65 to 74	63 to 75	68 to 76
Outside temperatures during loading, °F.	69 to 89	73 to 80	68 to 89	68 to 88
Brand	Daily	River	El Rio	River Gold
Routing	S.P., U.P., C.N.W., I.H.B., Erie	S.P., U.P., C.N.W., I.H.B., Erie	S.P., U.P., C.N.W., I.H.B., Erie	S.P., U.P., C.N.W., I.H.B., Erie

<sup>1/</sup> 40' cars, Preco floor fans, side wall flues, insulation 3" and 3-1/2", fixed bulkheads, excellent condition.

<sup>2/</sup> Bottom three layers 8 wide, top two layers 7 wide, 38 boxes to stack, 19 stacks, center braced, each layer stripped.





Table 2 Car Loading Data - Continued

California Bartlett Pear Transportation Test  
Sacramento, Calif., to New York City, July 11 - 20, 1950

Test Car	E	F	G	H
PFE <sup>1/</sup>	3546	3492	2636	3363
Loading Point	Walnut Grove	Walnut Grove	Dantoni	Hood
Shipper	Calif. Fruit Exchange	Calif. Fruit Exchange	DiGiorgio Fruit Corp.	Stillwater Orchards
Load	722 boxes <sup>2/</sup>	722 boxes <sup>2/</sup>	722 boxes <sup>2/</sup>	722 boxes <sup>2/</sup>
Protective Service	25 <sup>4a</sup>	25 <sup>4a</sup>	H. S., STD. Refrig.	H. S., STD. Refrig.
Fans	On	Off	On	Off
Loading time				
Start	9:45 A.M.	11:30 A.M.	8:10 A.M.	11:45 A.M.
Finish	11:25 A.M.	2:00 P.M.	2:00 P.M.	4:20 P.M.
Fruit temperatures during loading, °F.	69 to 74	68 to 76	63 to 69	66 to 70
Outside temperatures during loading, °F.	71 to 79	78 to 90	74 to 88	86 to 92
Brand	Elmwood	Elmwood	OH Yes	Daily
Routing	S.P., U.P., C.NW., I.H.B., Erie	S.P., U.P., C.NW., I.H.B., Erie	S.P., U.P., C.NW., I.H.B., Erie	S.P., U.P., C.NW., I.H.B., Erie



Table 3

## SCHEDULE OF TEST TRAIN

Origin Sacramento, CaliforniaDestination New York, N.Y.Commodity Bartlett PearsRouting S.P., U.P., C.N.W., I.H.B., ErieTest No. Bartlett-1-50

Arrived		Place	Departed	
Date	Time		Date	Time
		Roseville, California	July 12	6:20P.
July 13	4:00A.	Sparks, Nevada	" 13	6:30A.
" "	12:20P.	Inlay, "	" "	12:50P.
" "	5:30P.	Carlin, "	" "	7:30P.
" 14	2:15A. MT.	Montello, "	" 14	3:00A.
" "	7:45A.	Ogden, Utah	" "	2:40P.
" "	10:15P.	Green River, Wyoming	" 15	3:00A.
" 15	7:20A.	Rawlins, "	" "	8:10A.
" "	12:20P.	Laramie, "	" "	3:00P.
" "	7:45P.	Cheyenne, "	" "	10:15P.
" 16	1:00A. C.T.	Sidney, Nebr.	" 16	1:30A. C.T.
" "	5:45A.	North Platte, Nebr.	" "	8:30A.
" "	11:55A.	Grand Island, "	" "	12:47P.
" "	5:15P.	Omaha, Nebra.	" "	5:20P.
" "	5:30P.	Council Bluffs, Iowa	" 17	12:40A.
" 17	4:40A.	Boone, Iowa	" "	5:55A.
" "	1:20P.	Clinton, Iowa	" "	3:40P.
" "	8:30P.	Proviso, Ill.	" 18	12:30A.
" 18	3:40A.	Blue Island, Ill.	" "	6:40A.
" "	8:00A.	Hammond, Ind.	" "	11:15A.



Table 3 (Continued)

Arrived		Place	Departed	
Date	Time		Date	Time E.T.
July 18	6:50P.	Marion, Ohio	July 18	11:50P.
" 19	7:10A.	Meadville, Pa.	" 19	7:40A.
" 19	1:00P.	Hornell, N.Y.	" "	5:00P.
" 19	8:20P.	Susquehanna, N.Y.	" "	9:40P.
" 20	3:45A.	Croxtan Yards, N.J.	-----	-----



Table 4

## TEST TRIP ICING RECORD

Origin Sacramento River and Yuba City, CaliforniaDestination New York City, N.Y.Test No. Bartlett-1-50

Car No.,	Pacific Fruit Express			A	B	C	D	E	F
				3838	3692	3666	3647	3546	3492
Icing service,				HS 247b	HS 254b	254a	254	254a	254a
Commodity,	Bartlett			Pears	Pears	Pears	Pears	Pears	Pears
Fruit temperature at time of loading F°				72°-78°	65°-74°	63°-75°	68°-76°	69°-74°	68°-76°
Place	Date	Time		Pounds of Ice Supplied Each Car					
	July	Start	Finish						
			P.T.						
Sacramento, Calif.	10	5:30p	6:10p	6,500		11,500	11,500	11,500	
Marysville, "	10	4:00p	4:15p		11,500				
Walnut Grove, "	11	1:00p	1:15p			2,100			
Pearson, "	11	5:10p	5:20p		3,000				
Walnut Grove, "	11	8:00p	8:10p			3,000			
Roseville, "	12	1:30p	2:00p	6,500	5,200	6,700	7,600	7,800	
Roseville, "	12	3:25p	3:40p		3,000				
Carlin, Nev.	13	6:00p	6:15p C.T.	3,200	3,600				
Council Bluffs, Ia.	16	6:10p	6:35p	6,000			10,500	7,500	
Clinton, Ia.	17	1:45p	2:00p		6,400				
Blue Island, Ill.	18	4:40A	4:50A		10,000				
Total ice added				15,700	21,700	27,500	23,300	29,600	26,800
Ice remaining at unloading-									
Erie Pier, New York	20	7:30 PM		100	600	7,500	none	5,000	5,000
Total ice used				15,600	21,100	20,000	23,300	24,600	21,800





Table 4 (Continued)

## TEST TRIP ICING RECORD

Origin Sacramento River and Yuba City, CaliforniaDestination New York City, N.Y.Test No. Bartlett-1-50

Car No.,	Pacific Fruit Express	G	H
		2636	3363
Icing service,		HS Std.	HS Std.
Commodity,	Bartlett	Pears	Pears
Fruit temperature at time of loading, °F.		63°-69°	66°-70°
Place	Date	Time	
	July	Start	Finish
		Pounds of Ice Supplied Each Car	

Place	Date	Time		Pounds of Ice Supplied Each Car	
	July	Start	Finish		
		PT			
Roseville, Calif.	12	1:30p	2:00p		6,500
Roseville, "	12	3:25p	3:40p	6,500	
Sparks, Nev.	13	4:10A	4:25A	3,800	4,200
Carlin, "	13	6:00p	6:15p	2,700	2,300
		MT			
Ogden, Utah	14	9:35A	9:45A	1,200	1,200
Laramie, Wyo.	15	12:50p	1:00p	3,400	2,900
		CT			
Council Bluffs, Ia.	16	6:10p	6:35p	3,000	2,600
Clinton, Ia.	17	1:45p	2:00p	1,000	1,300
Blue Island, Ill.	18	4:40A	4:50A	900	800
Marion, Ohio	18	7:15p	7:20p	800	800
Eornell, N.Y.	19	1:15p	1:25p	1,000	1,100

---

Total ice added 24,300 23,700

Ice remaining at  
unloading-  
Erie Pier, New York 20 7:30 PM 4,500 4,500

---

Total ice used 19,800 19,200



Table 2 Condition of Pears in Test Boxes in Test Boxes - Bartlett Transportation Test - July, 1950  
 Test Lot #1, Stillwater Orchard, Sacramento River District, <sup>1/</sup>Harvested 7/10/50

Car	Position in car during transit	Fruit temperatures during transit period			Condition at unloading <sup>2/</sup> 7/21/50		
		Average for position of F.	Period in range of 55° to 75° F. Hours	Period below 50° F. Hours	Firmness Pounds <sup>3/</sup>	Color <sup>4/</sup>	Soluble Solids <sup>5/</sup>
A	Top doorway Bottom bunker	61.0 57.6	149 113	None 72	10.0 18.4	2.3 1.9	13.0 13.6
B	Top doorway Bottom bunker	61.2 57.8	191 179	None None	6.6 13.7	2.7 2.0	12.8 12.0
C	Top doorway Bottom bunker	46.6 45.3	41 22	171 188	19.8 21.6	1.6 1.5	12.4 12.4
D	Top doorway Bottom bunker	50.0 45.1	38 22	142 204	20.3 20.3	2.1 1.6	12.8 12.9
E	Top doorway Bottom bunker	54.3 48.0	78 38	115 170	20.5 20.3	1.5 1.5	12.4 12.3
F	Top doorway Bottom bunker	62.3 47.2	228 39	None 171	4.9 19.4	2.4 2.0	13.0 12.6
G	Top doorway Bottom bunker	53.6 50.7	87 72	115 133	21.1 20.1	1.6 1.5	12.8 12.9
H	Top doorway Bottom bunker	63.4 49.8	228 67	None 145	6.0 21.0	2.7 1.7	12.2 12.8

<sup>1/</sup> Condition at harvest - Pressure test 20 lbs; color 1.5; soluble solids 10.1

<sup>2/</sup> Using a 15 fruit sample taken from top to center of box.

<sup>3/</sup> By McGness-Taylor pressure tester.

<sup>4/</sup> By Standard Color Unit for Pears, Calif. State Dept. Agr.

<sup>5/</sup> Hand refractometer on extracted juice.



Table 5 (Continued) Condition of Pears in Test Boxes - Bartlett Transportation Test - July, 1950

Test Lot #2, New England Orchard, Yuba City District, <sup>1/</sup>Harvested 7/10/50

Car	Position in car during transit	Fruit temperatures during transit period				Condition at unloading <sup>2/</sup> 7/21/50		
		Average for position of F.	Period in range of 55° to 75° F. Hours	Period below 50° F. Hours	Firmness <sup>3/</sup> Pounds	Color <sup>4/</sup>	Soluble Solids <sup>5/</sup>	
A	Top doorway Bottom bunker	61.0 57.6	149 113	None 72	15.4 20.5	1.8 1.3	13.4 12.5	
B	Top doorway Bottom bunker	61.2 57.8	191 179	None None	13.4 14.0	2.0 1.9	11.8 12.8	
C	Top doorway Bottom bunker	46.6 45.3	41 22	171 188	21.7 21.8	1.3 1.5	12.2 12.7	
D	Top doorway Bottom bunker	50.0 45.1	38 22	142 204	21.1 22.2	1.3 1.6	12.2 13.0	
E	Top doorway Bottom bunker	54.3 48.0	78 38	115 170	22.2 21.9	1.4 1.5	12.7 13.0	
F	Top doorway Bottom bunker	62.3 47.2	228 39	None 171	6.3 21.1	2.6 1.3	12.4 12.2	
G	Top doorway Bottom bunker	53.6 50.7	87 72	115 133	22.7 21.4	1.5 1.5	12.6 13.0	
H	Top doorway Bottom bunker	63.4 49.8	228 67	None 145	16.8 22.1	1.4 1.4	12.4 12.3	

<sup>1/</sup> Condition at harvest - Pressure test 20 lbs; color 1.5; soluble solids 10.1

<sup>2/</sup> Using a 15 fruit sample taken from top to center of box.

<sup>3/</sup> By Megness-Taylor pressure tester.

<sup>4/</sup> By Standard Color Chart for Pears, Calif. State Dept. Agr.

<sup>5/</sup> Hand refractometer on expressed juice.



Table 6 Test Box Records During Holding Period at New York City  
July 21 to Aug. 4, 1950

Ripening room held at 67° - 68° F., 70% R.H., with ventilation and circulation.  
Test Lot #1, Stillwater Orchard, Sacramento River District, Harvested 7/10/50.

Car	Position in car during transit	Average fruit temp. during transit - °F.	Time required to reach eating ripe condition - Days	Time salable after reaching eating ripe stage - Days	Total time marketable after unloading - Days
A	Top doorway	61.0	4	4	8
	Bottom bunker	57.6	4	6	10
B	Top doorway	61.2	3	5	8
	Bottom bunker	57.8	3	7	10
C	Top doorway	46.6	7	5	12
	Bottom bunker	45.3	7	6	13
D	Top doorway	50.0	6	4	10
	Bottom bunker	45.1	6	7	13
E	Top doorway	54.3	7	6	13
	Bottom bunker	48.0	7	7	14
F	Top doorway	62.3	3	4	7
	Bottom bunker	47.2	6	6	12
G	Top doorway	53.6	6	4	10
	Bottom bunker	50.7	7	4	11
H	Top doorway	63.4	3	4	7
	Bottom bunker	49.8	7	4	11





Table 6 (Continued) Test Box Records During Holding Period at New York City  
 July 21 to Aug. 4, 1950

Ripening room held at 67° - 68° F., 70% R.H., with ventilation and circulation.  
 Test Lot #2, New England Orchard, Yuba City District, Harvested 7/10/50.

Car	Position in car during transit	Average fruit temp. during transit - °F.	Time required to reach eating ripe condition - Days	Time salable after reaching eating ripe stage - Days	Total time marketable after unloading - Days
A	Top doorway	61.0	4	6	10
	Bottom bunker	57.6	6	4	10
B	Top doorway	61.2	3	4	7
	Bottom bunker	57.8	4	3	7
C	Top doorway	46.6	9	1	10
	Bottom bunker	45.3	8	2	10
D	Top doorway	50.0	6	3	9
	Bottom bunker	45.1	6	4	10
E	Top doorway	54.3	8	3	11
	Bottom bunker	48.0	7	5	12
F	Top doorway	62.3	4	3	7
	Bottom bunker	47.2	10	3	13
G	Top doorway	53.6	7	3	10
	Bottom bunker	50.7	8	3	11
H	Top doorway	63.4	4	4	8
	Bottom bunker	49.8	9	3	12



Table 1 Condition of Bartlett Pears\* Held at Simulated Transit Temperatures  
Harvested July 10, 1950.

Source of fruit	At Harvest				After 10 days Storage				Total days marketable after storage
	Firmness pounds	Color by chart	Soluble Solids percent	Storage Temp. °F.	Firmness pounds	Color by Chart	Soluble Solids percent		
Stillwater Orchard									
Sacramento	19.9	1.5	10.2	44	19.5	2	12.0	6	
River	20.1	1.5	10.2	50	11.5	3-	12.5	5	
District	19.9	1.5	10.0	59	12.8	2.5	9.0	4	
New England Orchard									
Tuba	21.4	1.5	11.0	44	19.0	2-	12.0	6	
City	21.4	1.5	11.0	50	11.7	2.5	13.0	5	
District	21.4	1.5	11.0	59	9.1	3	11.0	4	

\* Test boxes from same lots as those included in test cars. Held and examined at Davis, California.







FIGURE 2  
 BARTLETT PEAR TRANSIT TEMPERATURES  
 JULY - 1950

CAR A - PFE 3838

UPPER HALF STAGE ICING  
 RESTRICTED AIR THROUGH BUNKERS  
 RULE 247b - INITIAL ICE AT  
 ROSEVILLE, RE-ICE AT CARLIN,  
 NEV., AND COUNCIL BLUFFS, IOWA,  
 FAN CAR, FANS ON.

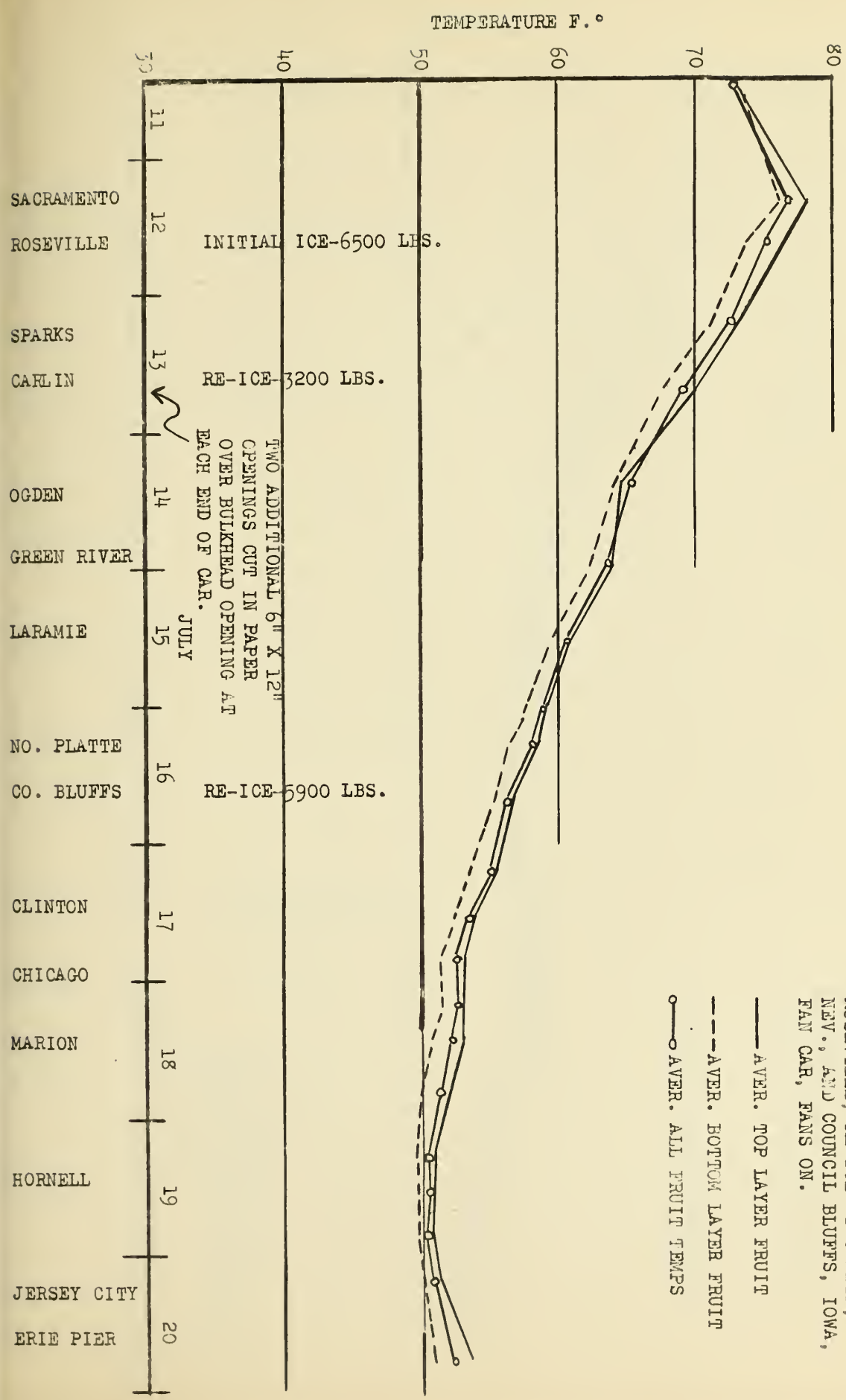






FIGURE 3

BARTLETT PEAR TRANSIT TEMPERATURES  
JULY - 1950

CAR B - PFE 3692

UPPER HALF STAGE ICING  
RESTRICTED AIR THROUGH BUNKERS  
RULE 254b - PRE-ICED BEFORE  
LOADING.\*  
REPLENISHED AT ROSEVILLE, RE-  
ICED AT CARLIN, NEV., AND  
CLINTON, IA. FAN CAR, FANS ON.

\*PRE-ICE - 6500 LBS., SACRAMENTO, JULY 10, 5:30 PM

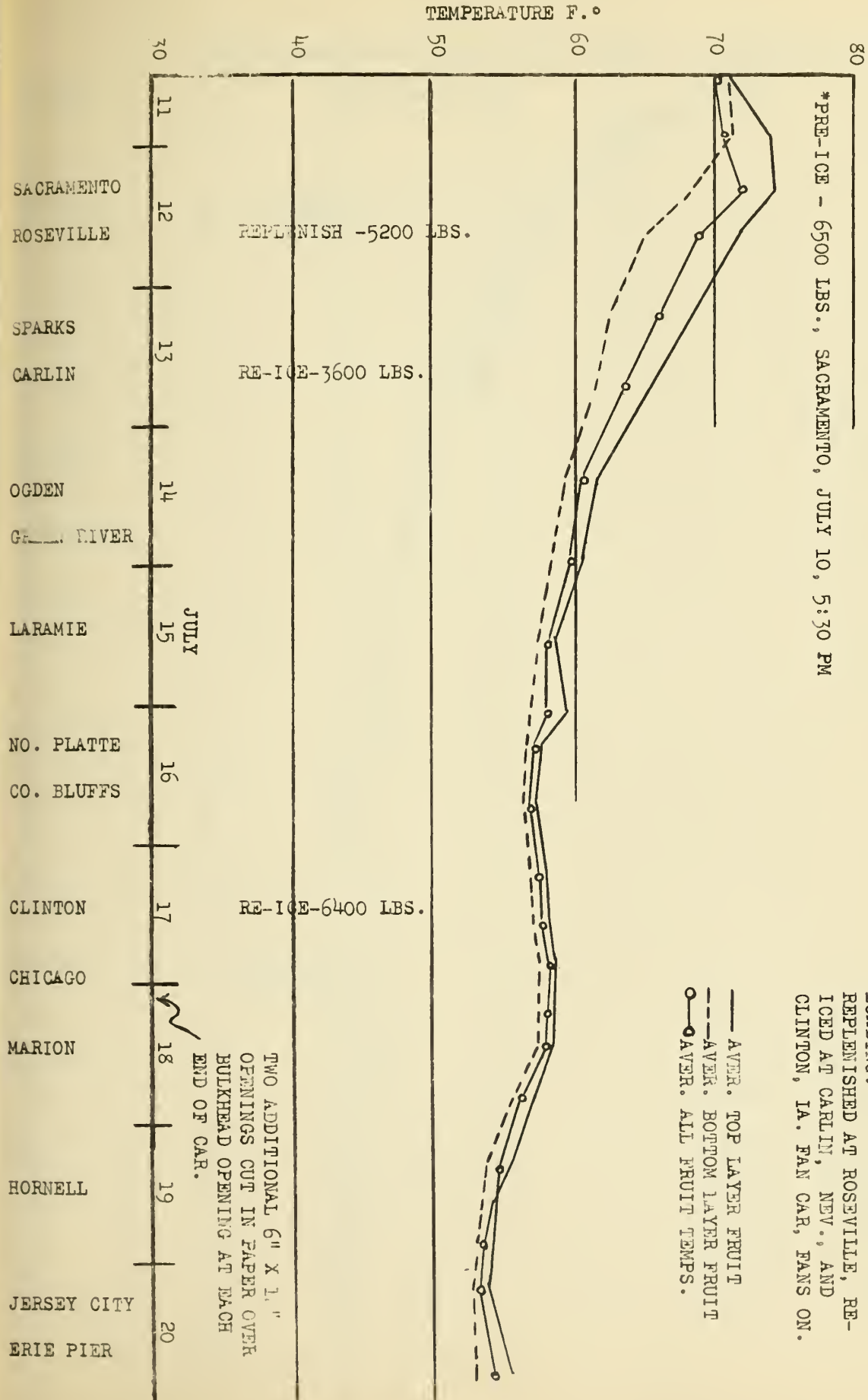


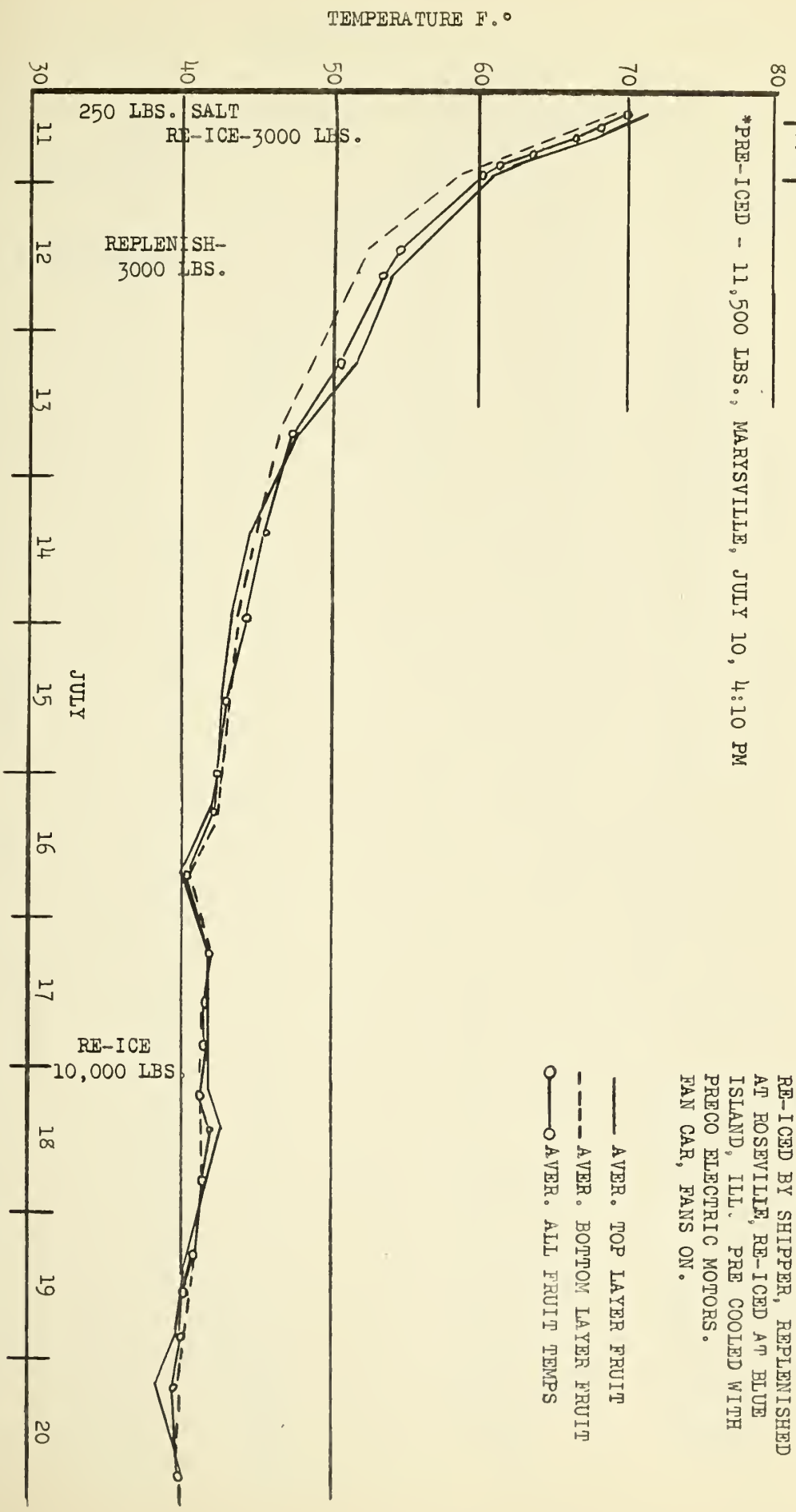


FIGURE 4

BARRETT PEAR TRANSIT TEMPERATURES  
JULY - 1950

CAR C - PFE 3666

FULL BUNKER ICING, RULE 254a,  
PRE-ICED BEFORE LOADING.\*  
RE-ICED BY SHIPPER, REPLENISHED  
AT ROSEVILLE, RE-ICED AT BLUE  
ISLAND, ILL. PRE COOLED WITH  
PRECO ELECTRIC MOTORS.  
FAN CAR, FANS ON.





TEMPERATURE F. °

FIGURE 5

BARTLETT PEAR TRANSIT TEMPERATURES

JULY - 1950

CAR D - PEE 3647

PRE-COOLING PERIOD

\*PRE-ICED - 11,500 LBS., SACRAMENTO, JULY 10, 5:30 PM

FULL BUNKER ICING, RULE 254, PRE-ICED BEFORE LOADING.\* PRE-ICED BY SHIPPER, REPLENISHED AT ROSEVILLE, FAN CAR, FANS ON, PRECOOLED BY PORTABLE KEROSENE MOTORS.

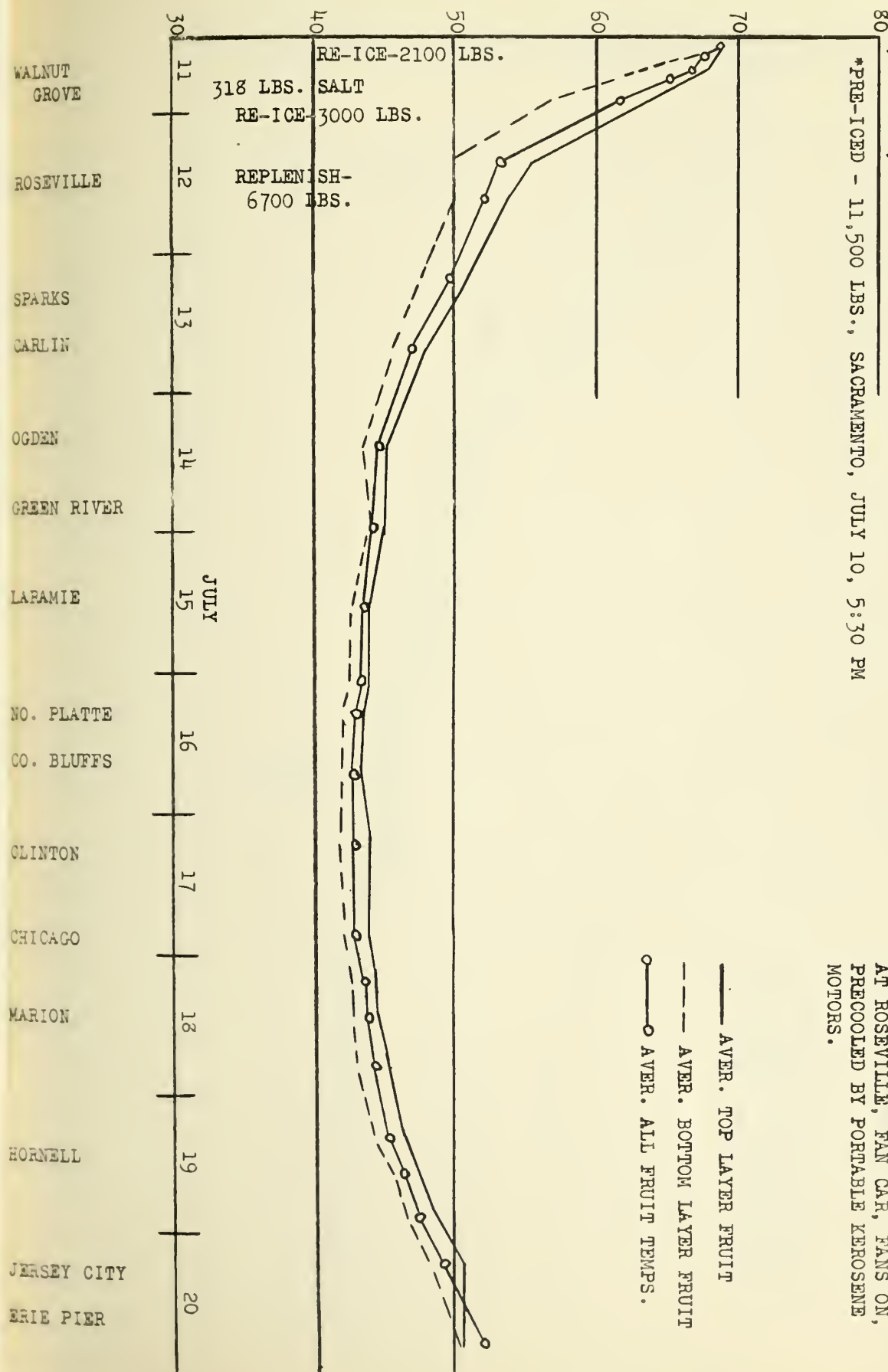


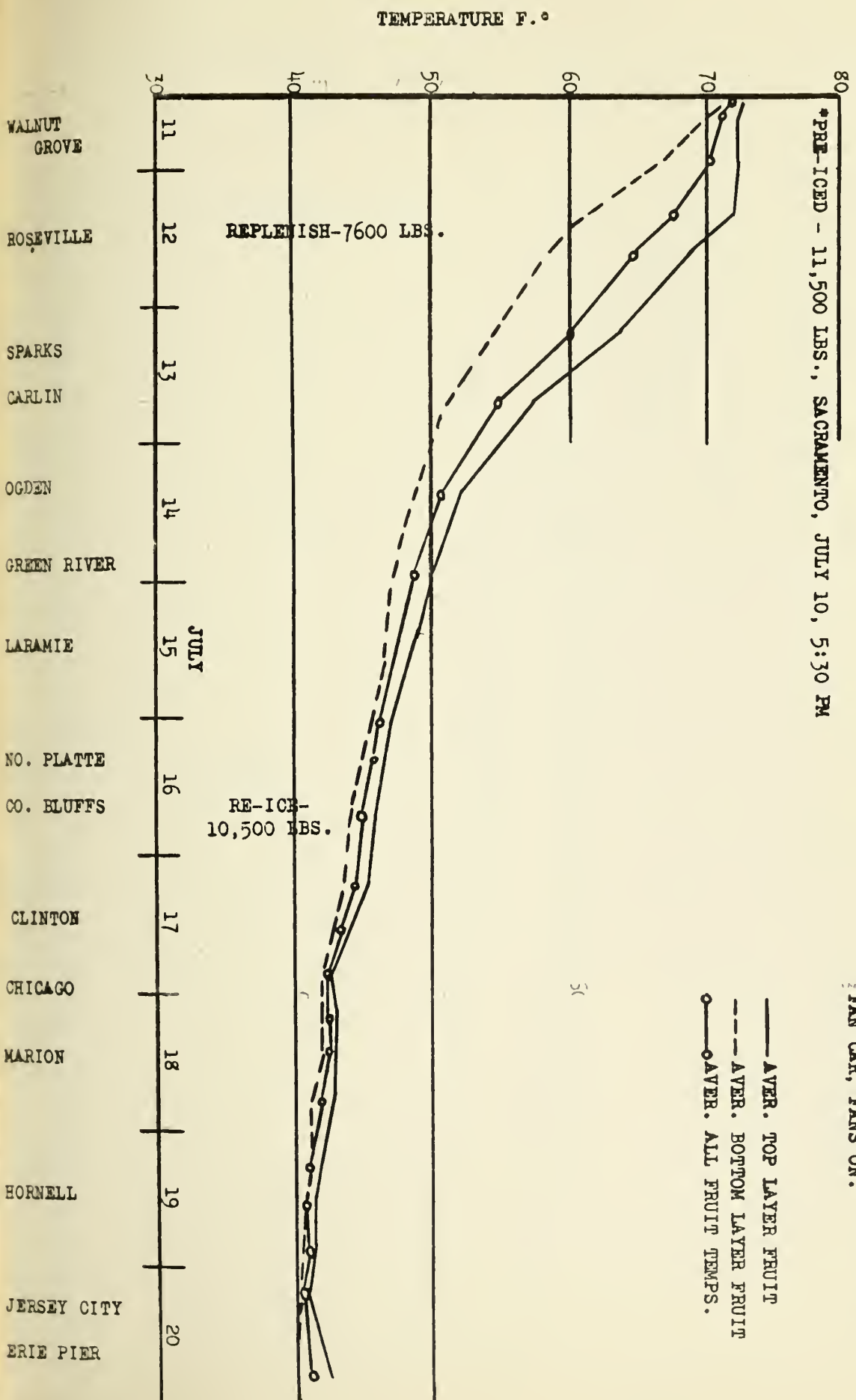


FIGURE 6

BARTLETT PEAR TRANSIT TEMPERATURES  
JULY - 1950

CAR # - PFE 3546

FULL BUNKER ICING, RULE 254a,  
PRE-ICED BEFORE LOADING.\*  
REPLENISHED AT ROSEVILLE,  
RE-ICED AT COUNCIL BLUFFS, IA.  
FAN CAR, FANS ON.



1880

1880

30

30

30

30

30

30

30

30



FIGURE 7

BARLETT PEAR TRANSIT TEMPERATURES  
JULY - 1950

CAR F - PEE 3492

FULL BUNKER ICING, RUL 254a,  
PRE-ICED BEFORE LOADING.\*  
REPLENISHED AT ROSEVILLE,  
RE-ICED AT COUNCIL BLUFFS, IA.  
FAN CAR, FANS OFF.

\*PRE-ICED - 11,500 LBS., SACRAMENTO, JULY 10, 5:30 PM

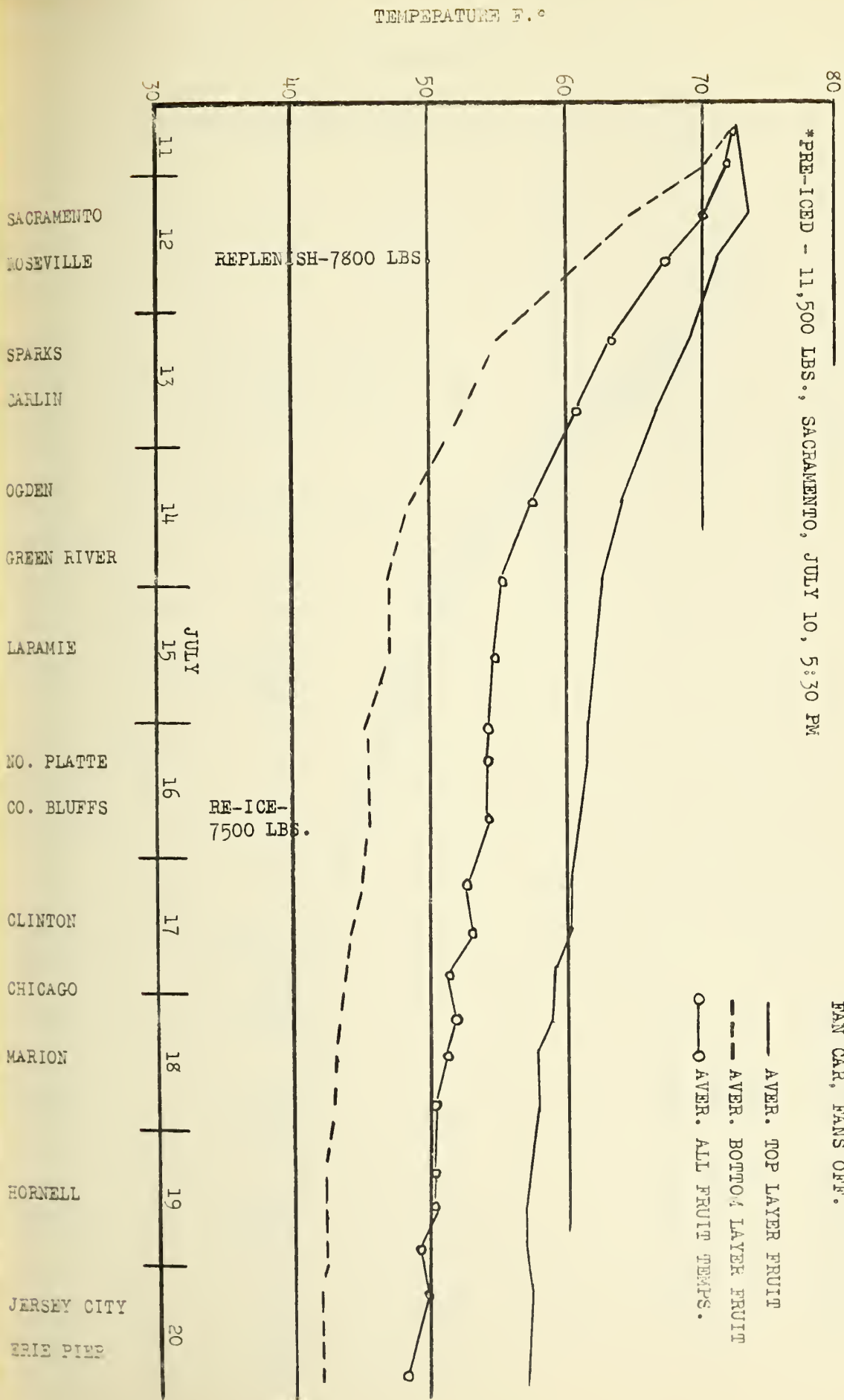
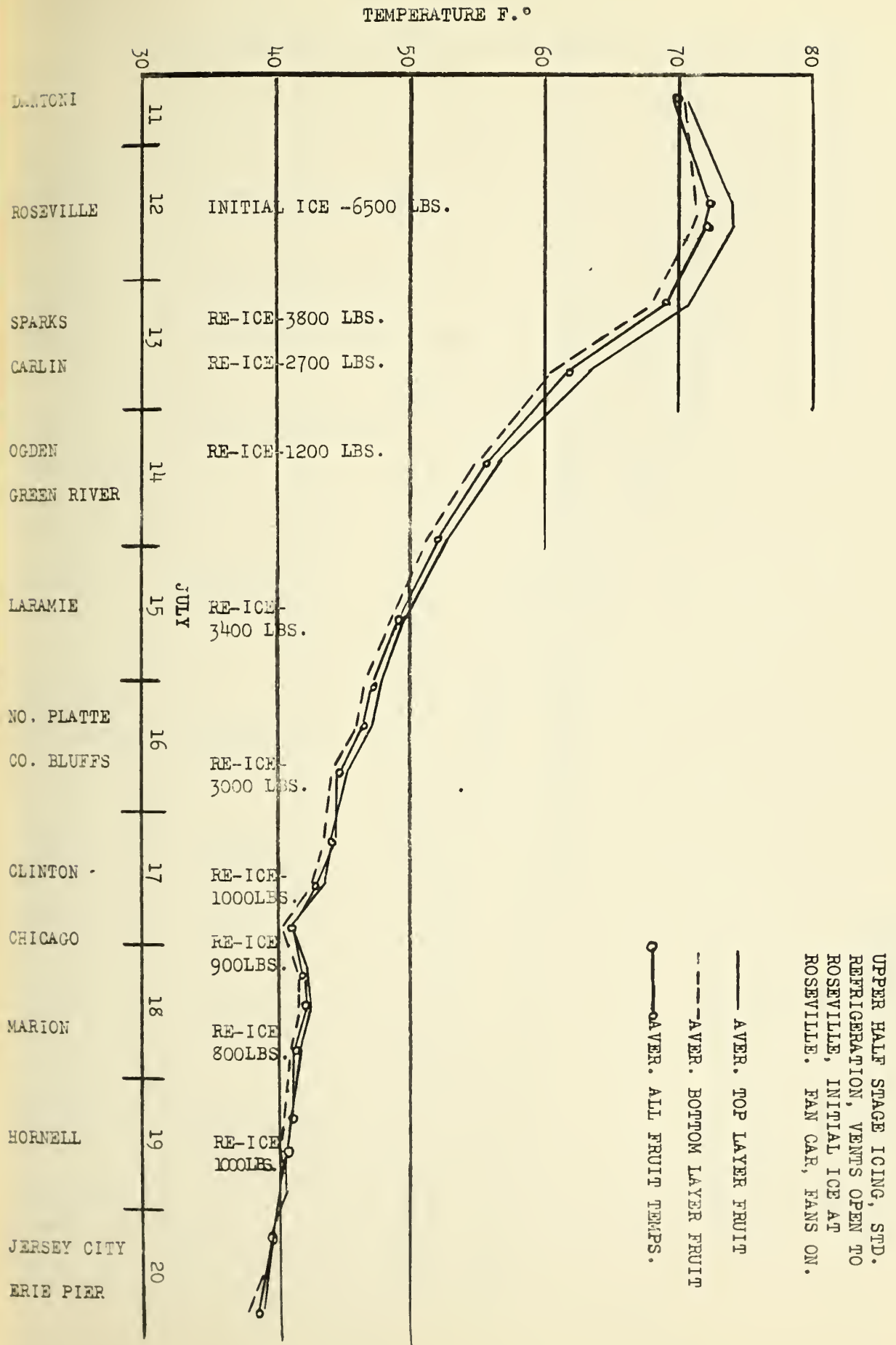




FIGURE 8

BARTLETT PEAR TRANSIT TEMPERATURES  
JULY - 1950

CAR G - PFE 2636





TEMPERATURE F. °

FIGURE 9

BARTLETT PEAR TRANSIT TEMPERATURES  
JULY - 1950

CAR H - PFE 3363

UPPER HALF STAGE ICING, STD. REFRIGERATION, VENTS OPEN TO ROSEVILLE, INITIAL ICE AT ROSEVILLE. FAN CAR, FANS OFF.

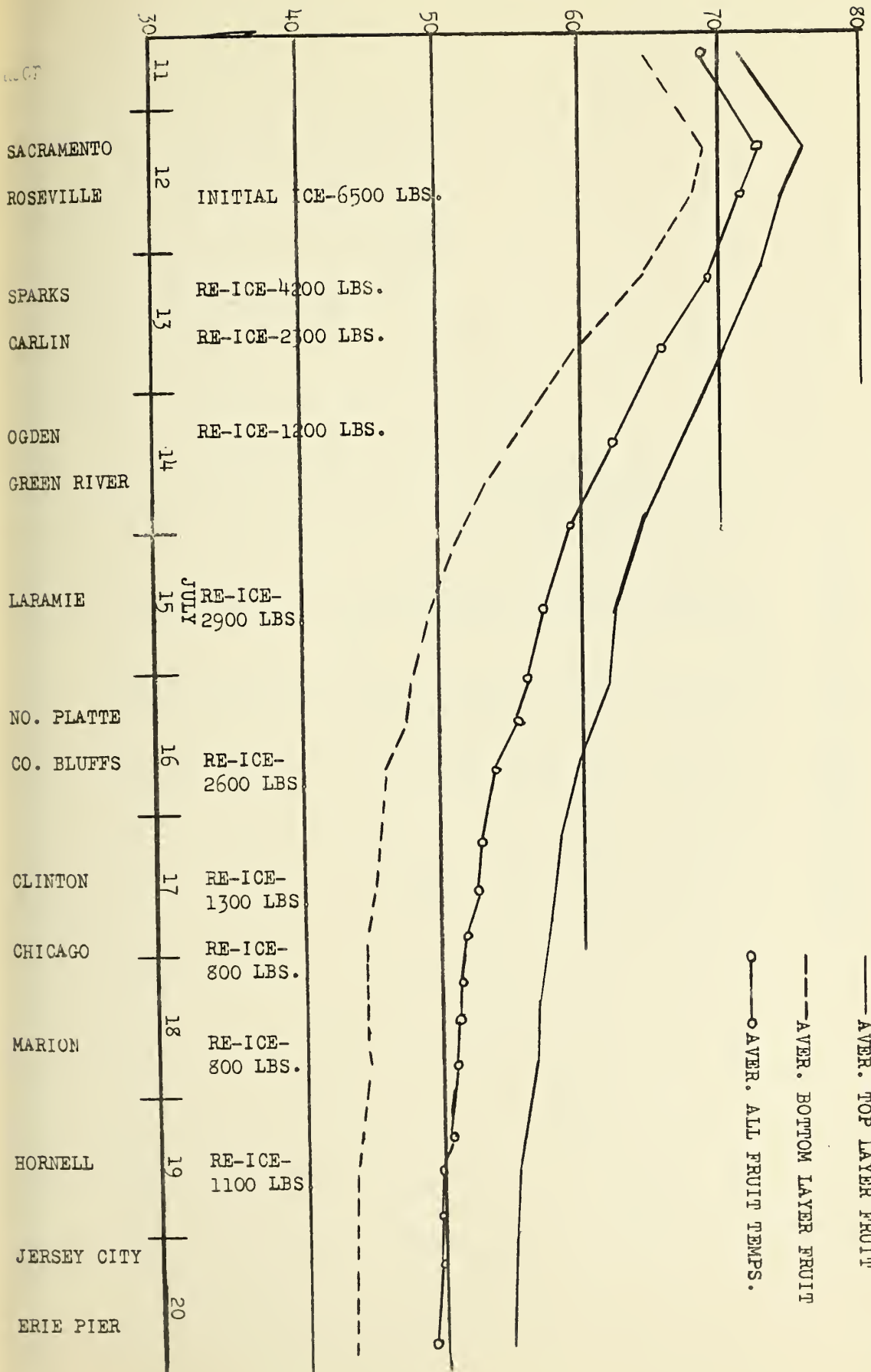




FIGURE 10 - NEGATIVE CORRELATION BETWEEN FIRMNESS OF BARLBLETT PEARS AT UNLOADING AND PERIOD EXPOSED TO RIPENING TEMPERATURE DURING TRANSIT

TEST LOT 1, STILLWATER ORCHARD

TEST BOXES AT TOP DOORWAY POSITION

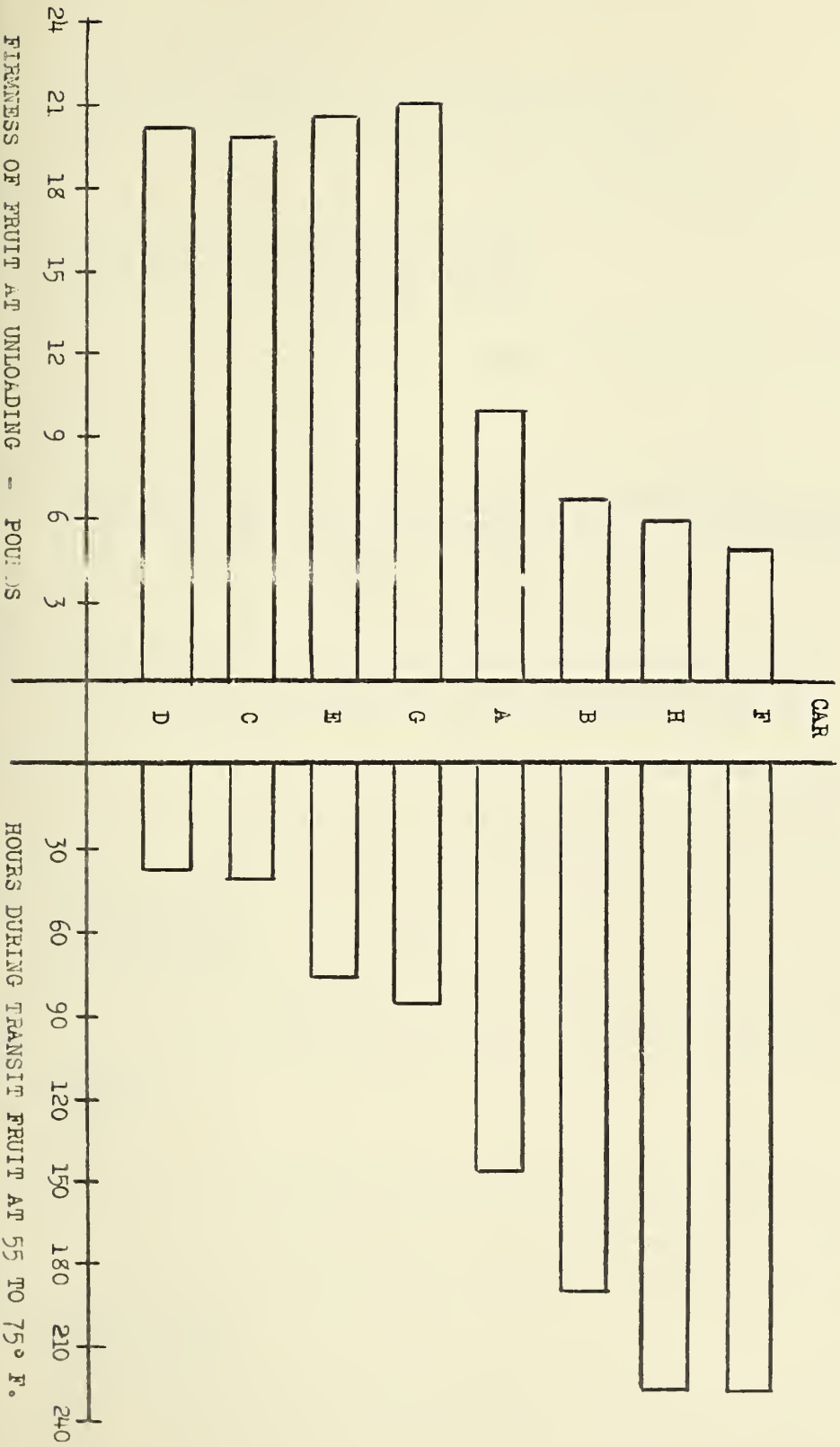
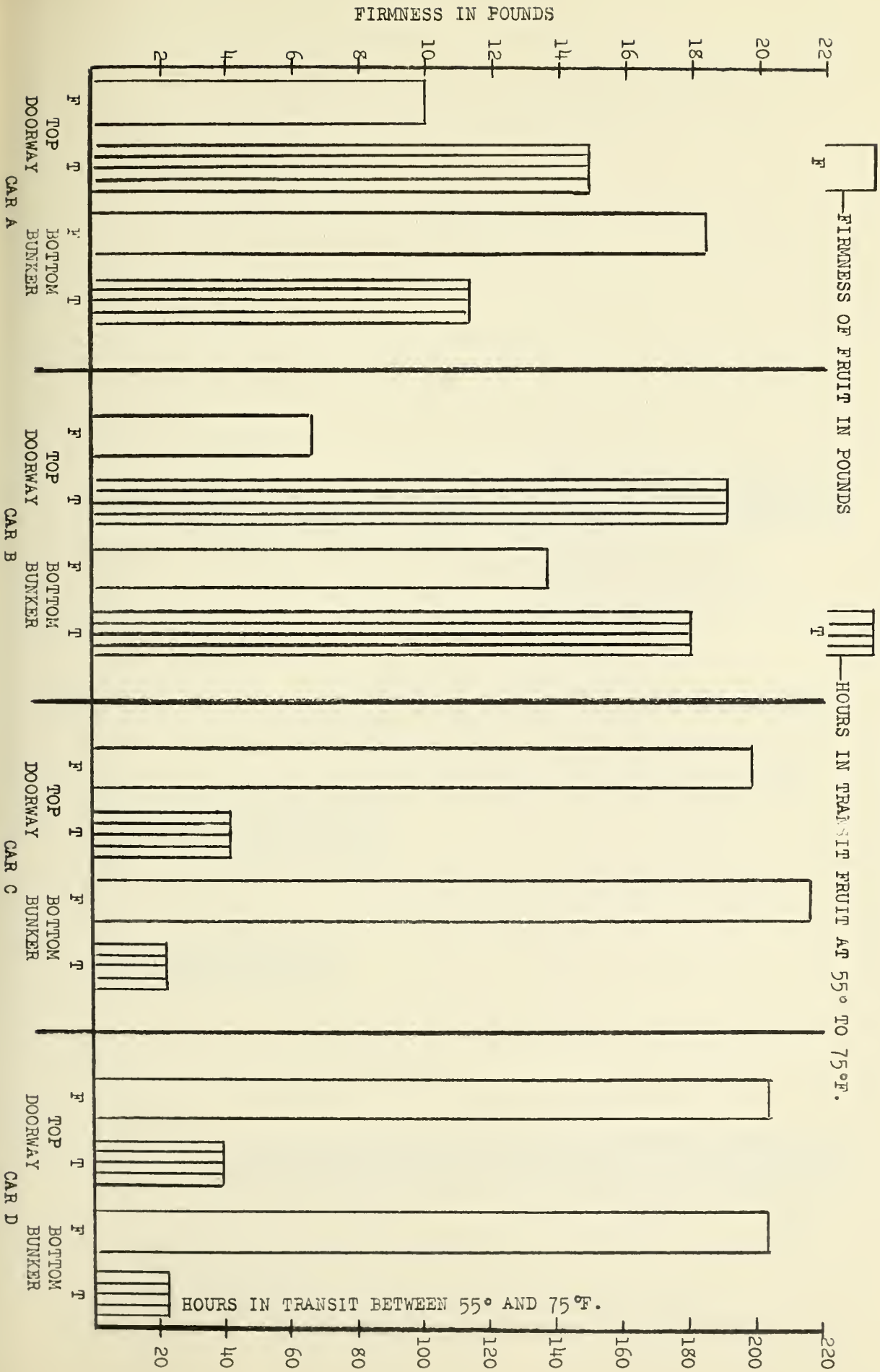






FIGURE 11 - FIRMNESS OF BARTELLETT PEARS AT UNLOADING AS RELATED TO PERIOD EXPOSED TO RIPENING TEMPERATURES TEST LOT 1, STILLWATER ORCHARD





FIRMNESS IN POUNDS

FIGURE 12

FIRMNESS OF BARLLETT PEARS AT UNLOADING AS RELATED TO PERIOD EXPOSED TO RIPENING TEMPERATURES TEST LOT 1, STILLWATER ORCHARD

